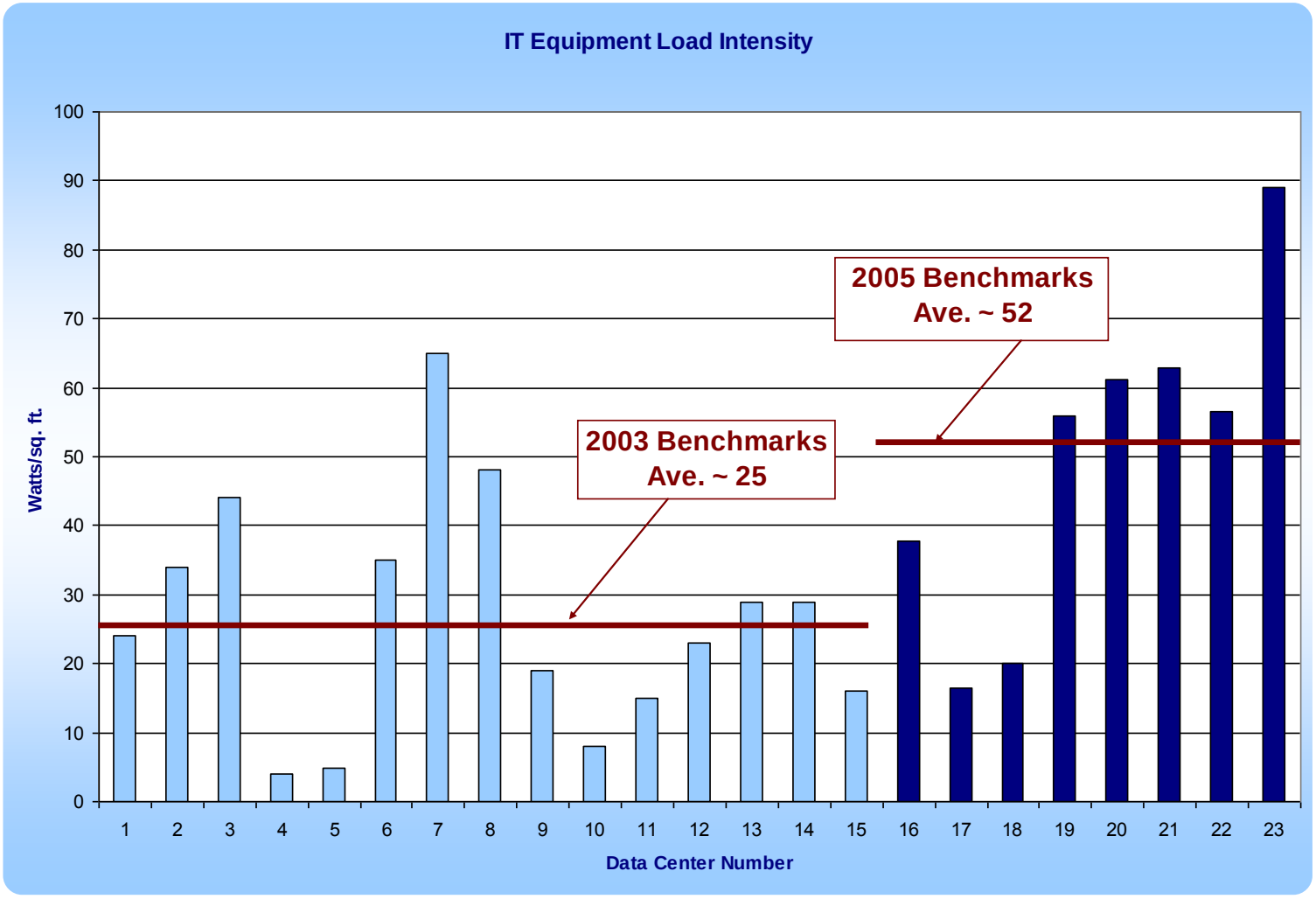
Benchmarking

<Presenter>

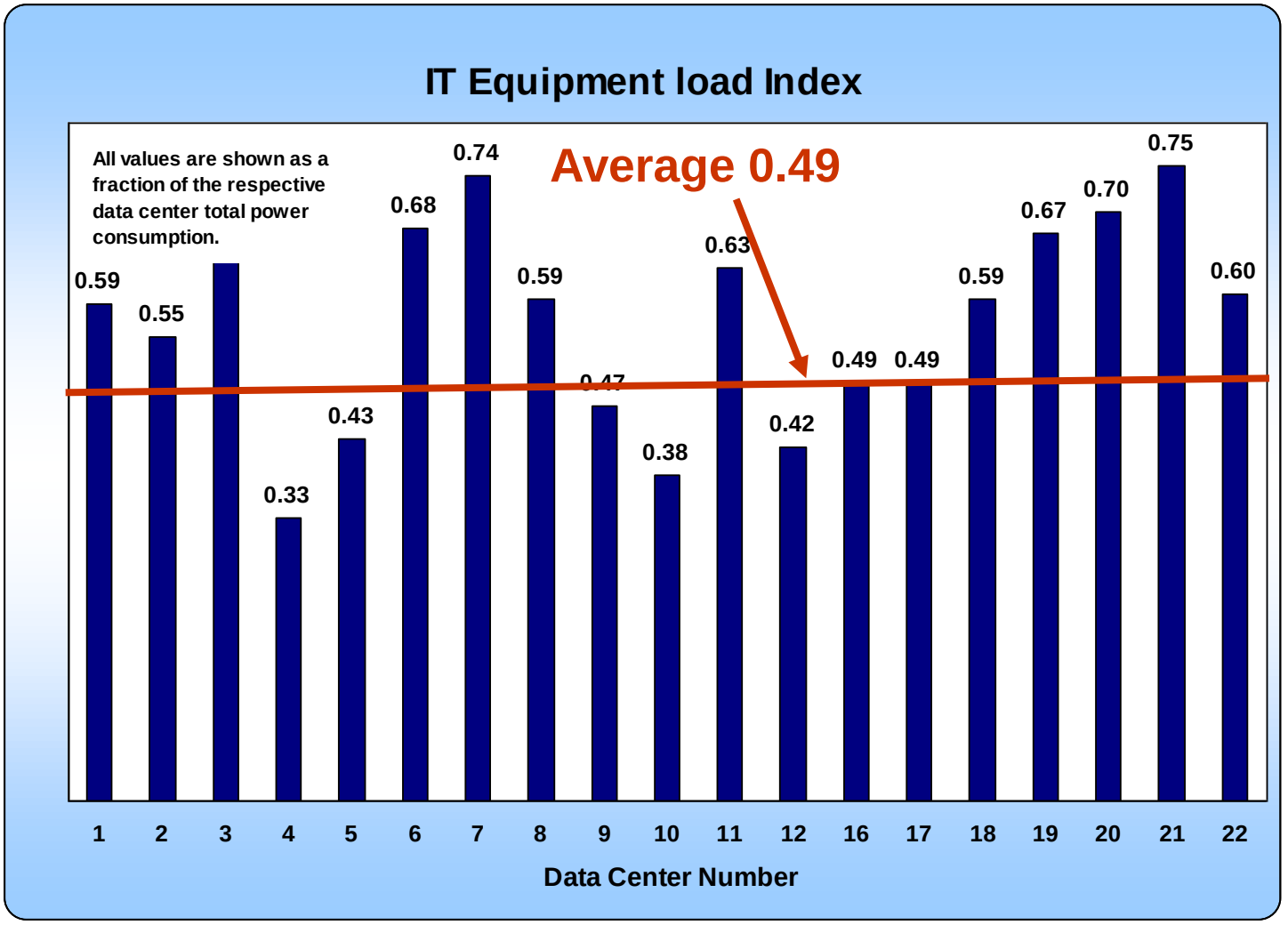
Benchmark Results Can Help Identify Best Practices

The ratio of IT equipment power to the total is an indicator of relative overall efficiency. Examination of individual systems and components in the centers that performed well helped to identify best practices.

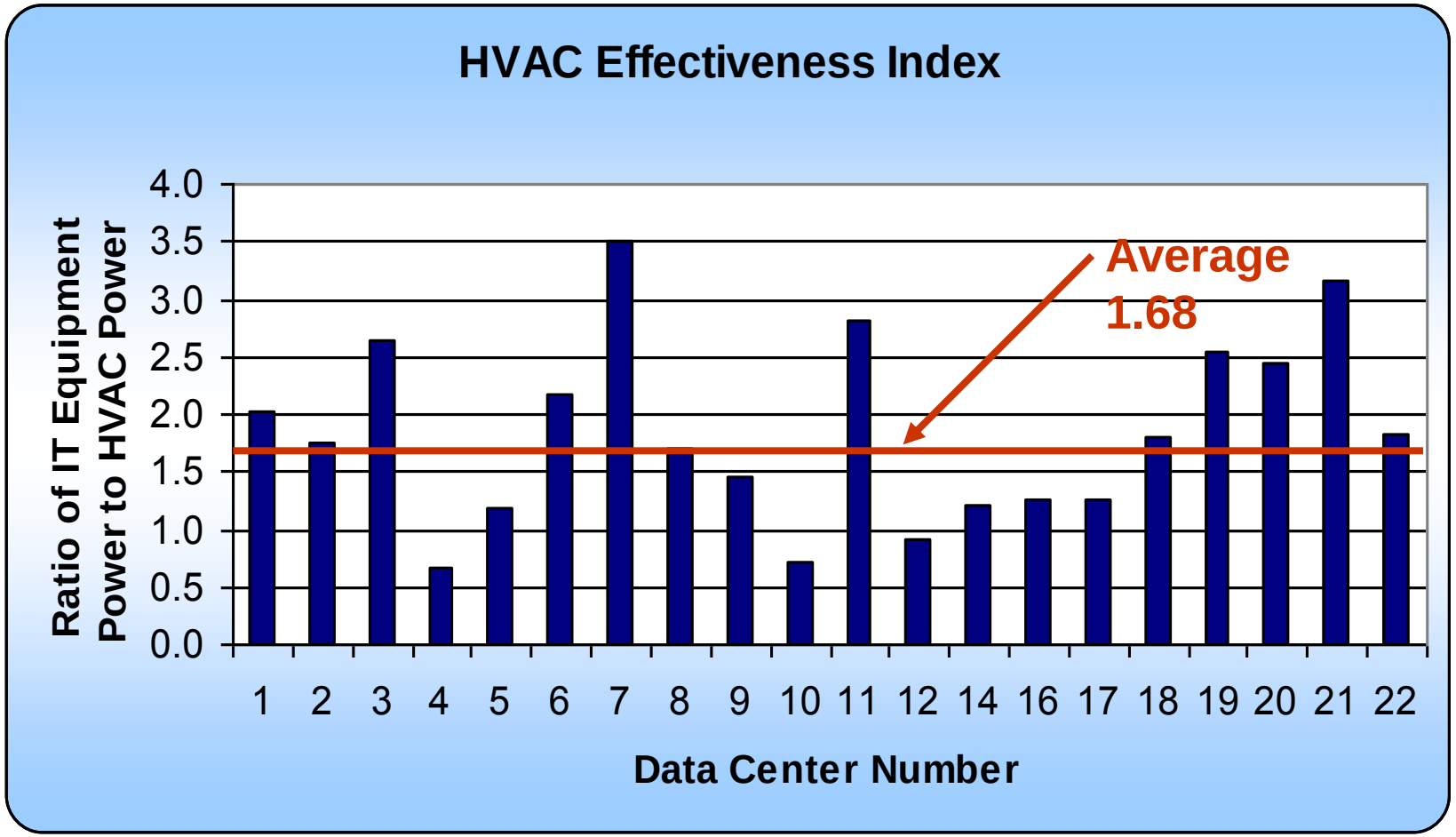
IT Equipment Load Density



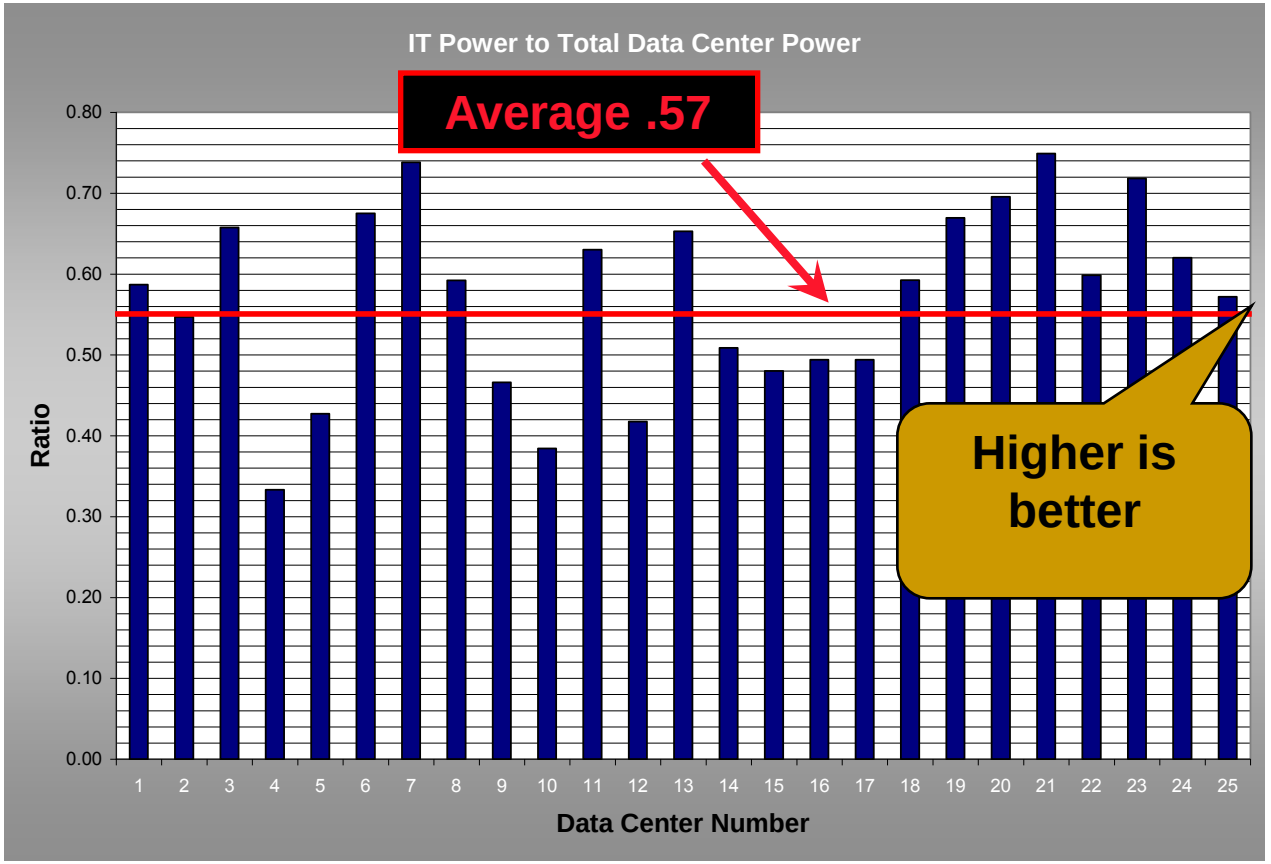
Percentage of Power to IT Equipment



HVAC System Effectiveness

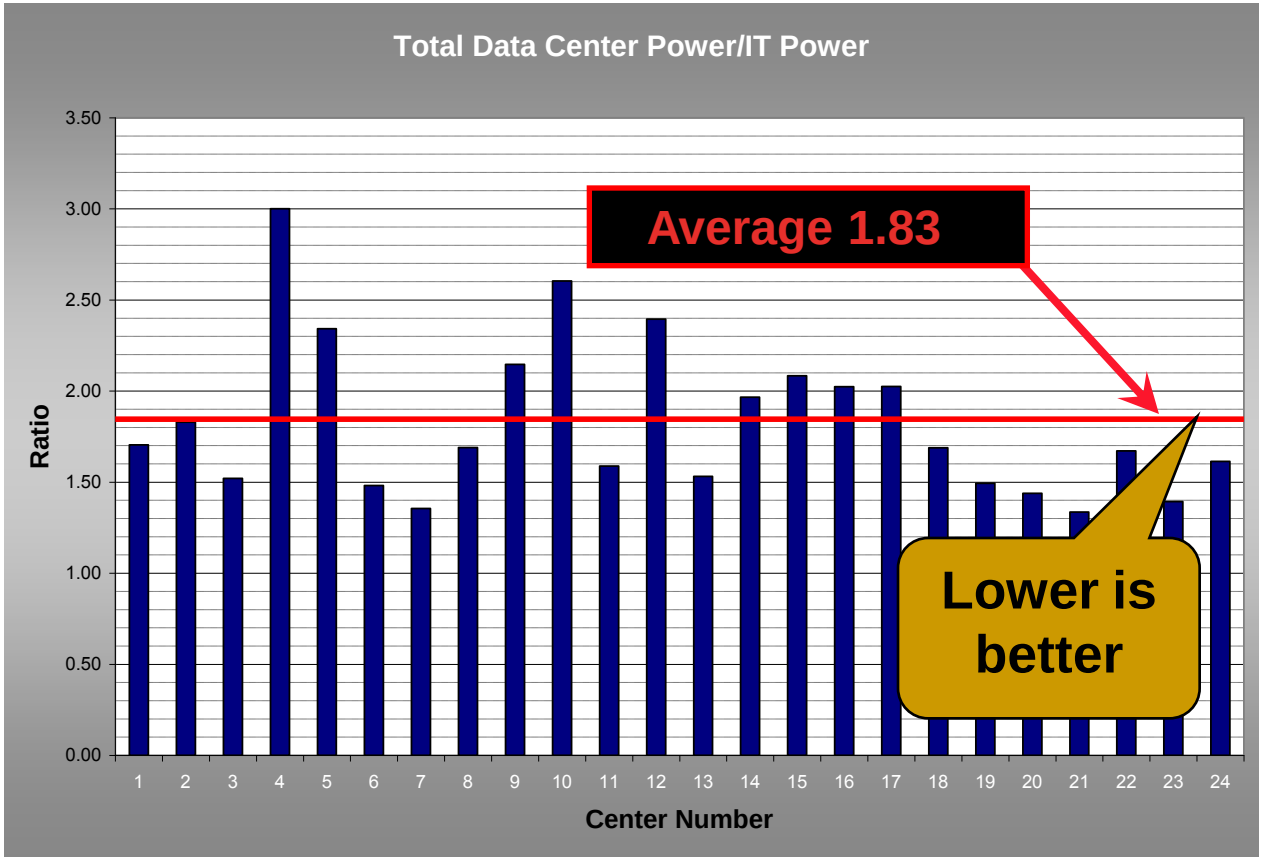


High Level Metric—
Ratio of Electricity Delivered to IT Equipment



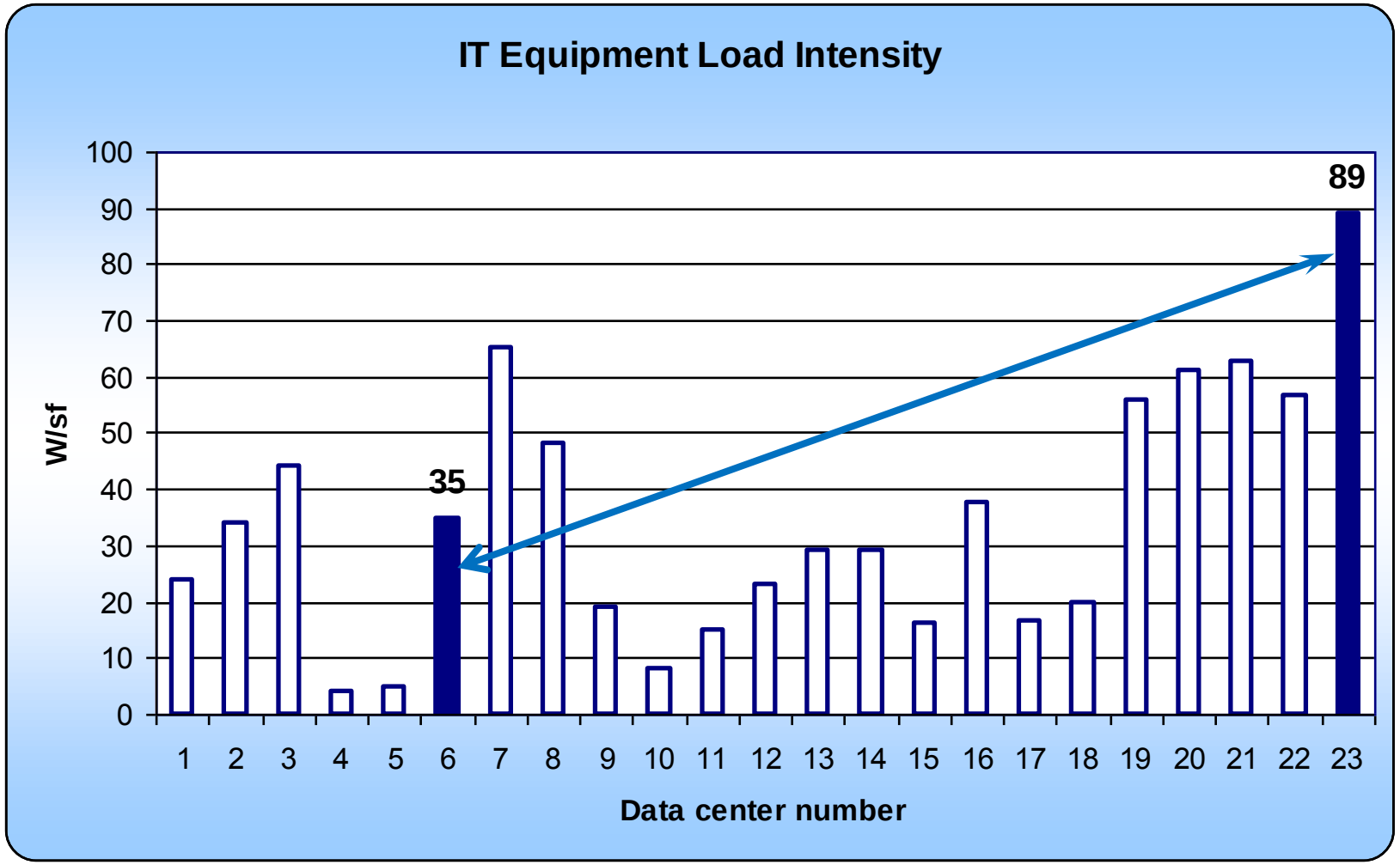
Source: LBNL Benchmarking

Alternate High Level Metric – Data Center Total / IT Equipment (PUE)



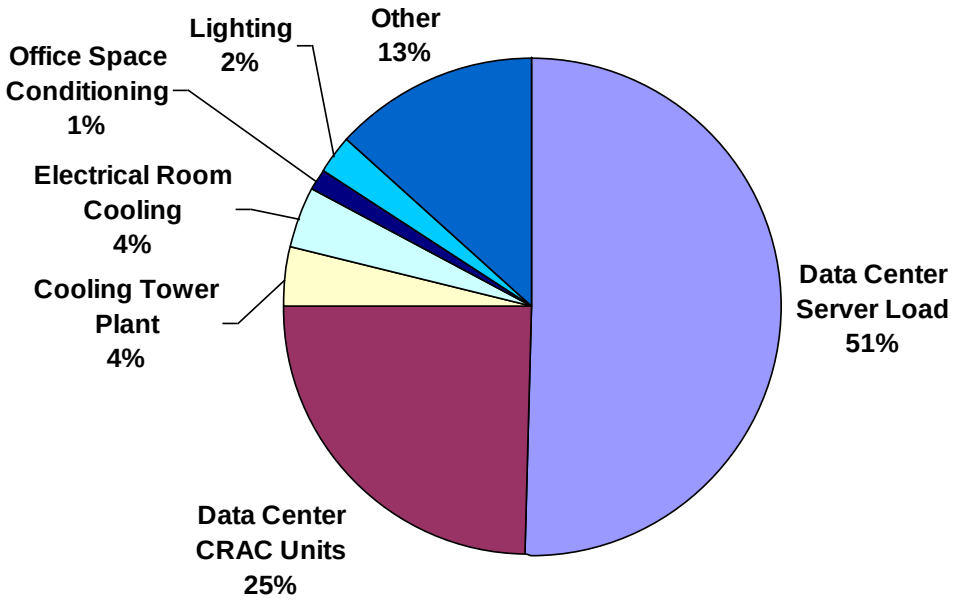
Source: LBNL Benchmarking

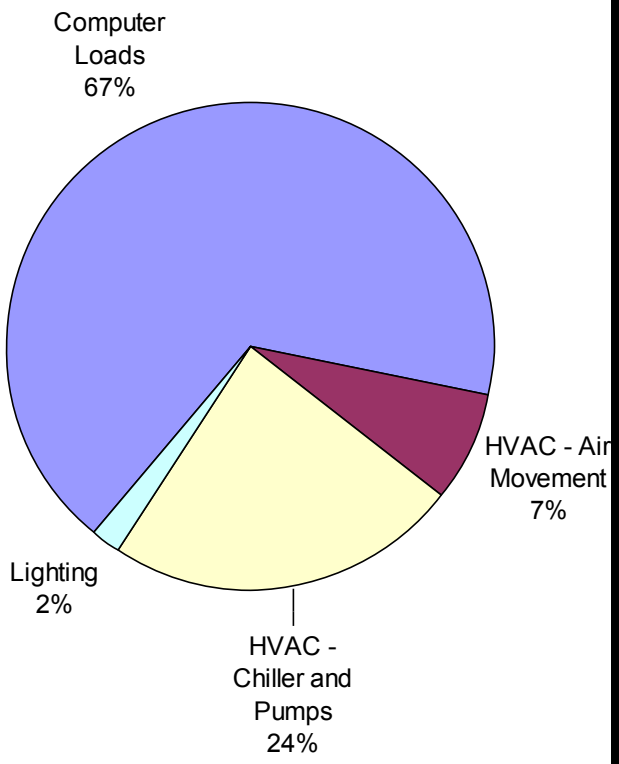
Change in LBNL's supercomputer center



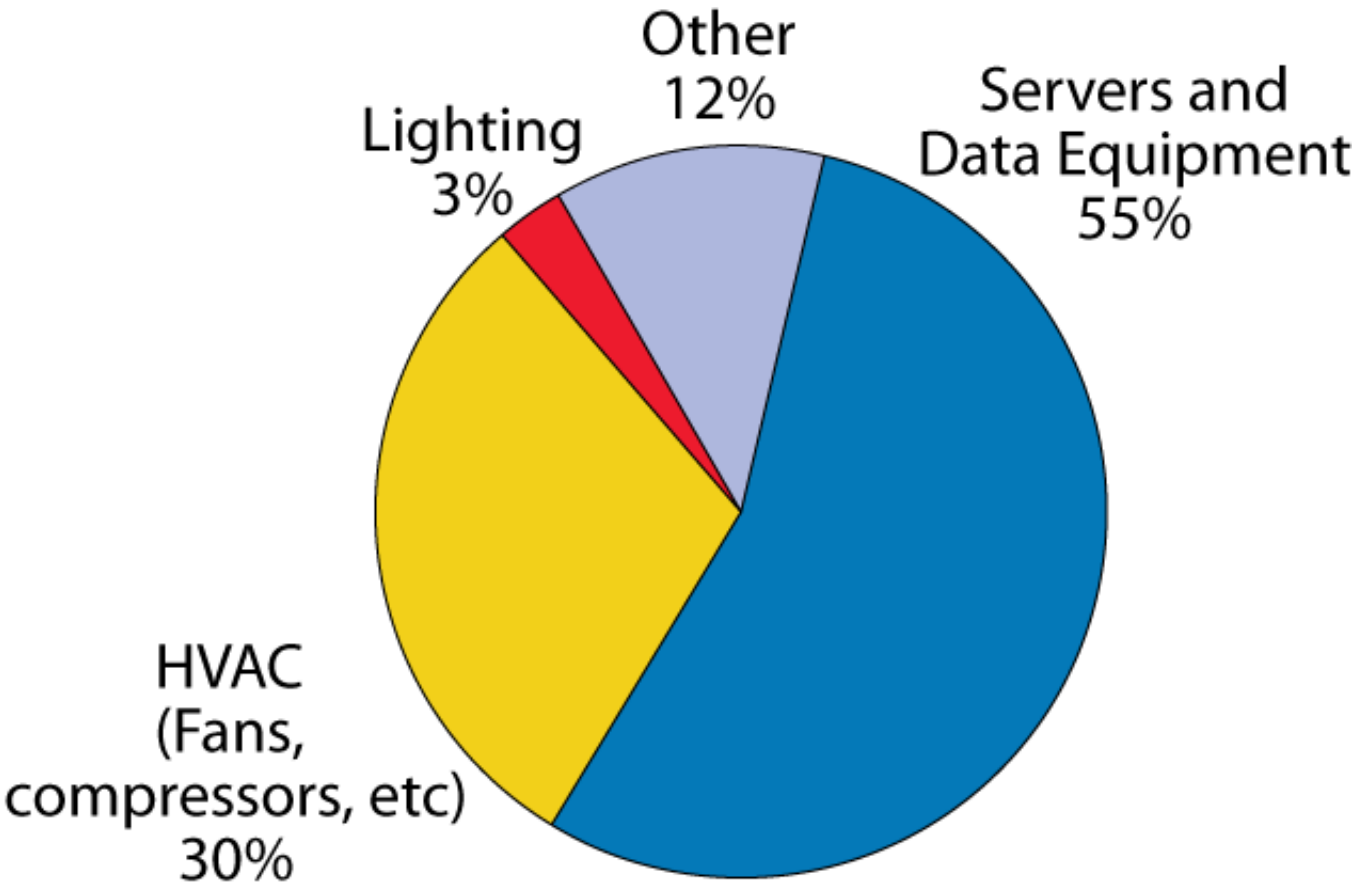
Performance varies

The relative percentages of the energy actually doing computing varied considerably.



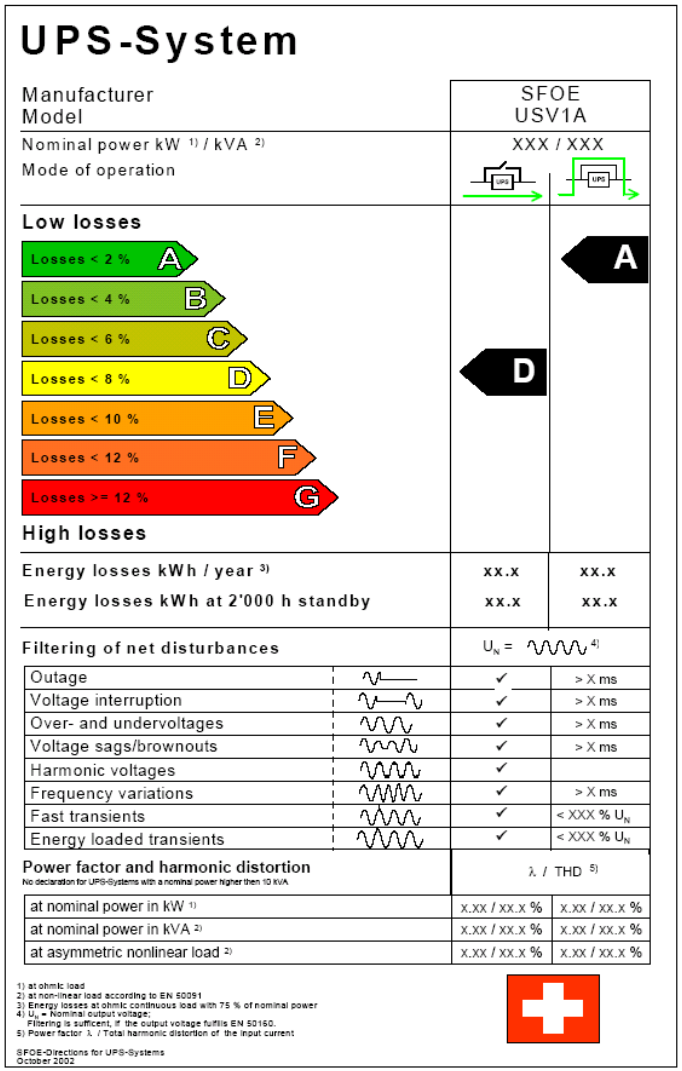


Energy use in Data Centers (LBNL/PG&E)



UPS Draft Labeling Standard

- Based upon proposed European Standard
- Possible use in incentive programs



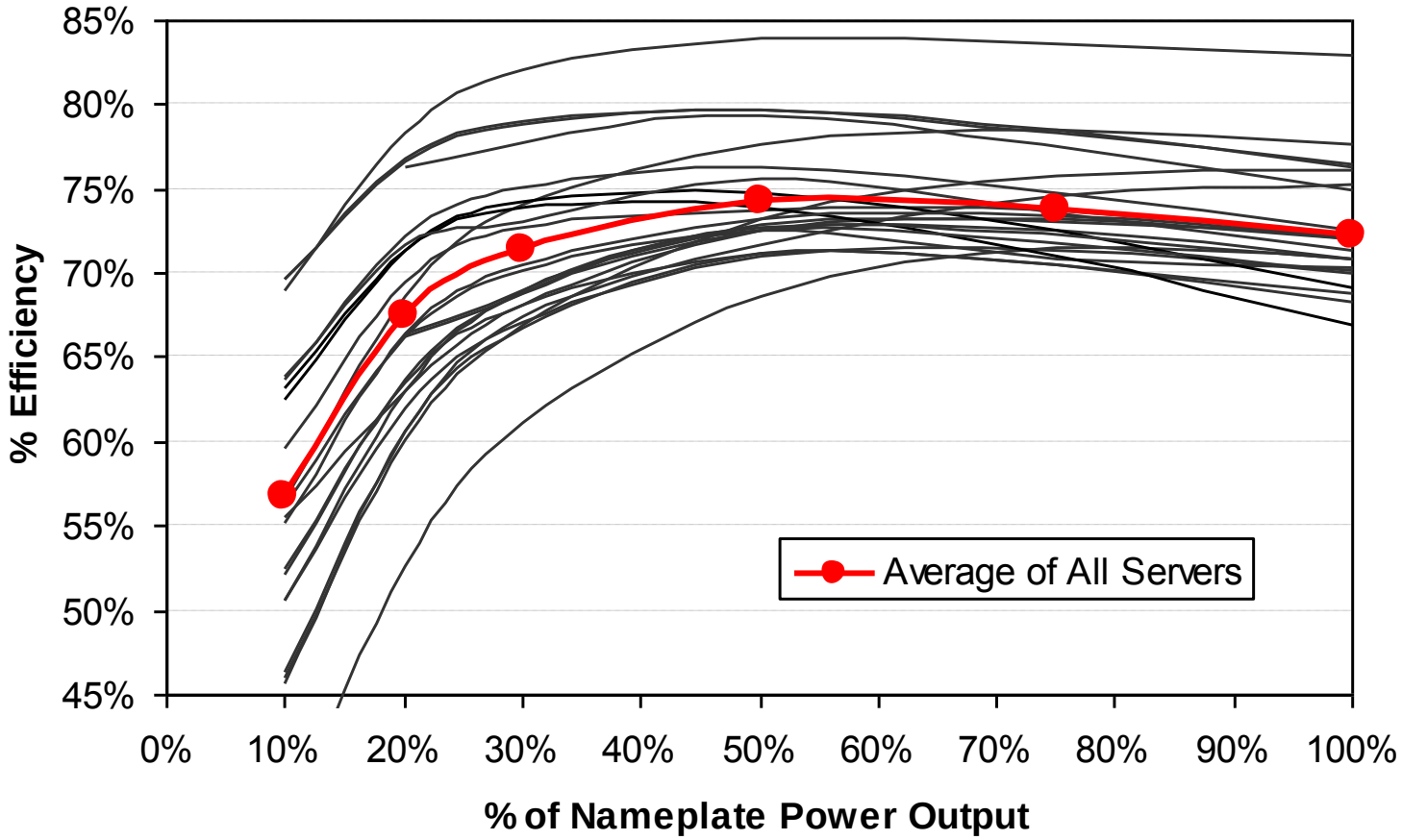
UPS-System

Manufacturer		SFOE
Model		USV1A
Nominal power kW [1] / kVA [2]		XXX / XXX
Mode of operation		
Low losses		
Losses < 2 % A		A
Losses < 4 % B		
Losses < 6 % C		
Losses < 8 % D	D	
Losses < 10 % E		
Losses < 12 % F		
Losses >= 12 % G		
High losses		
Energy losses kWh / year [3]	xx.x	xx.x
Energy losses kWh at 2'000 h standby	xx.x	xx.x
Filtering of net disturbances	U_N = [4]	
Outage	✓	> X ms
Voltage interruption	✓	> X ms
Over- and undervoltages	✓	> X ms
Voltage sags/brownouts	✓	> X ms
Harmonic voltages	✓	
Frequency variations	✓	> X ms
Fast transients	✓	< XXX % U_N
Energy loaded transients	✓	< XXX % U_N
Power factor and harmonic distortion (No declaration for UPS-Systems with a nominal power higher then 10 kVA)	λ / THD [5]	
at nominal power in kW [1]	x.xx / xx.x %	x.xx / xx.x %
at nominal power in kVA [2]	x.xx / xx.x %	x.xx / xx.x %
at asymmetric nonlinear load [2]	x.xx / xx.x %	x.xx / xx.x %

1) at ohmic load
2) at non-linear load according to EN 50091
3) Energy losses at ohmic continuous load with 75 % of nominal power
4) U_N = Nominal output voltage;
Filtering is sufficent, if the output voltage fulfils EN 50160.
5) Power factor λ / Total harmonic distortion of the input current

SFOE-Directions for UPS-Systems
October 2002

Measured power supply efficiency



Take Aways

- Various meanings for —data centers”
- Benchmarking helps identify performance
- Benchmarking suggests best practices
- Efficiency varies
- Large opportunity for savings
- Resources are available